General

Guideline Title

Inpatient diagnosis and treatment of central vascular catheter (CVC) infections.

Bibliographic Source(s)

University of Michigan Health System. Inpatient diagnosis and treatment of central vascular catheter (CVC) infections. Ann Arbor (MI): University of Michigan Health System; 2016 Dec. 17 p. [35 references]

Guideline Status

This is the current release of the guideline.

This guideline meets NGC's 2013 (revised) inclusion criteria.

Recommendations

Major Recommendations

Note from the University of Michigan Health System (UMHS) and the National Guideline Clearinghouse (NGC): The following guidance was current as of December 2016. Because UMHS occasionally releases minor revisions to its guidance based on new information, users may wish to consult the original guideline document for the most current version.

Note from NGC: The following key points summarize the content of the guideline. Refer to the original guideline document for additional information.

The strength of recommendation (I-III) and levels of evidence (A-E) are defined at the end of the "Major Recommendations" field.

Key Points

Diagnosis (see Figure 1 in the original guideline document)

- In any patient with a central vascular catheter (CVC) and clinical suspicion for line infection, blood cultures should be drawn. Do not draw blood cultures routinely via a CVC, unless CVC infection is suspected. *[IA]*
- Blood cultures should be obtained prior to the initiation of antibiotics, *unless* the patient is unstable or critically ill (necessitating immediate initiation of antimicrobials, regardless of whether blood cultures have been obtained). *[IB]*
    - When infection is suspected, at least 2 sets of cultures should be drawn (aerobic & anaerobic). *[IIB]*
    - Blood cultures should be drawn from peripheral site and the central line if catheter infection is suspected *[IB]*. Blood cultures should not be drawn from central catheters routinely. *[IIID]*

Treatment

- Empiric treatment should be initiated after blood cultures are obtained (see Figure 2 in the original guideline document). *[IC]*
- Definitive antimicrobial therapy should be tailored to the organism identified and the susceptibilities of that organism (see Table 1 in the original guideline document). *[IC]*
- The preferred management of confirmed CVC infection includes removal of the central vascular catheter in most cases. *[ID]*
- There are different considerations for short-term and non-tunneled hemodialysis CVC (see Figure 3 in the original guideline document), long-term CVC (see Figure 4 in the original guideline document), and tunneled hemodialysis CVC (see Figure 5 in the original guideline document). *[IC]*
- Unless there is an urgent need for central vascular access, new central vascular catheter placement should be delayed until 48 hours after the first negative blood cultures when treating any bacteremia, including CVC-related bacteremia. *[IC]*
- CVC removal and infectious disease consultation is recommended for any of the following situations related to CVC infections: cultures positive for *Staphylococcus aureus* or *Candida* species; persistent bacteremia with any organism after 72 hours of appropriate antimicrobial therapy; persistence of septic shock; presence of an intravascular prosthetic device (e.g., mechanical valve, pacemaker, or automatic implantable cardioverter-defibrillator [AICD]); or development of any complication (e.g., endocarditis, osteomyelitis, suppurative thrombophlebitis, or others). *[IC]*

Definitions

Levels of Evidence

A. Systematic reviews of randomized controlled trials
B. Randomized controlled trials
C. Systematic review of non-randomized controlled trials or observational studies, non-randomized controlled trials, group observation studies (e.g., cohort, cross-sectional, case-control)
D. Individual observation studies (case study or case series)
E. Opinion of expert panel

Strength of Recommendation

I. Generally should be performed
II. May be reasonable to perform
III. Generally should not be performed

Clinical Algorithm(s)

The following algorithms are provided in the original guideline document:

- Approach to Diagnosis of Central Vascular Catheter Infections
- Empiric Antimicrobial Therapy for CVC Infections
- Catheter Management for Infected Short-term CVCs and Non-tunneled Hemodialysis CVCs
- Catheter Management for Infected Long-term CVC
- Catheter Management for Tunneled Hemodialysis CVC
- Definitive Treatment of Uncomplicated CVC Infection

Scope

Disease/Condition(s)

Central vascular catheter (CVC) infections

Note: Excluded from the scope of the guideline:

- Extracorporeal membrane oxygenation (ECMO) catheters
- Umbilical catheters
- Peripheral catheters, such as midline catheters, peripheral venous or peripheral arterial catheters
- Prevention of central catheter infections

Guideline Category

Diagnosis

Evaluation

Management

Treatment

Clinical Specialty

Critical Care

Emergency Medicine

Infectious Diseases

Internal Medicine

Pediatrics

Intended Users

Advanced Practice Nurses

Hospitals

Physician Assistants

Physicians

Guideline Objective(s)

To improve appropriate early antimicrobial treatment of bloodstream infections, standardize management of central vascular catheter (CVC) infections, and improve patient outcomes associated with CVC infections

Target Population

Patients of all ages with suspected central vascular catheters (CVC) infection

Interventions and Practices Considered

Diagnosis

1. Blood cultures (aerobic and anaerobic) from peripheral site and central line
2. Timing of cultures

Treatment

1. Empiric antimicrobial therapy
    - Vancomycin
    - Beta-lactam/beta-lactamase combination (e.g., piperacillin/tazobactam)
    - Fourth generation cephalosporin (e.g., cefepime)

    - Empiric antifungal therapy
2. Definitive antimicrobial therapy based on microorganism
3. Removal of central vascular catheter (CVC) versus catheter salvage
4. Considerations for management of infected short-term and non-tunneled hemodialysis CVC, long-term CVC, and tunneled hemodialysis CVC
5. Delay of new vascular catheter placement when treating any bacteremia
6. Infectious disease consultation

Major Outcomes Considered

- Sensitivity/specificity of diagnostic test or procedure
- Time to improvement
- Cure rate
- Infection rate
- Complications of infections
- Mortality

Methodology

Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Strategy for Literature Search

Within the Medline (Ovid) database, the following search strategy was used for most of the search topics, except for the searches on suppurative thrombosis, endocarditis, and vascular infection. The search below is identified as Main in the search strategies document. Because the appropriate indexing terms either do not exist or were applied inconsistently, the main search uses keywords in addition to MeSH terms to arrive at the following main strategy.

1. *Central Venous Catheters/ or *Catheterization, Central Venous/ or (central line or central lines or ("central venous" and (catheter* or line or lines)) or "central line associated" or "catheter related").ti.
2. ("peripherally inserted central" and (line or lines or port or ports or catheter*)).mp. or (PICC or PICCS).ti,ab. or *catheters, indwelling/
3. 1 or 2
4. Cross Infection/ or exp *Sepsis/ or exp *Catheter-Related Infections/ or exp *Bacterial Infections/ or *infection/ or *Prosthesis-Related Infections/
5. 3 and 4
6. (CLABSI* or CRBSI* or CR-BSI*).ti,ab.
7. 5 or 6

The searches on suppurative thrombosis, endocarditis, and vascular infection used the first 3 searches of the main search strategy. The MEDLINE In-Process search was based entirely on keywords.

Results were limited to: Humans, English, and 2008 to current. The Main search retrieved 391 references. When the search hedges for Guidelines, Clinical Trials, and Cohort Studies were added, the base results are as follows:

- Central Line Infection - Guidelines, total results were 28
- Central Line Infection - Clinical Trials, total results were 187
- Central Line Infection - Cohort Studies, total results were 402

The search was conducted in components each keyed to a specific causal link in a formal problem structure (available from the guideline authors

upon request). The search was supplemented with very recent clinical trials known to expert members of the panel. Negative trials were specifically sought. The search was a single cycle.

Search details and evidence tables available in the methods companion (see the "Availability of Companion Documents" field).

Number of Source Documents

The review process resulted in 35 studies identified as best evidence.

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Levels of Evidence

A. Systematic reviews of randomized controlled trials
B. Randomized controlled trials
C. Systematic review of non-randomized controlled trials or observational studies, non-randomized controlled trials, group observation studies (e.g., cohort, cross-sectional, case-control)
D. Individual observation studies (case study or case series)
E. Opinion of expert panel

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

After the best evidence was identified, it was organized into evidence tables. Evidence identified by the literature review was carried forward as best evidence unless the subsequent search for this guideline identified better evidence.

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

Guideline recommendations were based on prospective randomized controlled trials (RCTs) if available, to the exclusion of other data; if RCTs were not available, observational studies were admitted to consideration. If no such data were available for a given link in the problem formulation, expert opinion was used to estimate effect size. The "strength of recommendation" for key aspects of care was determined by expert opinion.

Rating Scheme for the Strength of the Recommendations

Strength of Recommendation

I. Generally should be performed
II. May be reasonable to perform

III. Generally should not be performed

Cost Analysis

A formal cost analysis was not performed and published analyses were not reviewed.

Method of Guideline Validation

Internal Peer Review

Description of Method of Guideline Validation

Drafts of this guideline were reviewed in clinical conferences and by distribution for comment within departments and divisions of the University of Michigan Medical School to which the content is most relevant: Internal Medicine, Infectious Diseases, Pediatrics, Pediatric Emergency Medicine, Pediatric Infectious Diseases. The Executive Committee for Clinical Affairs of the University of Michigan Hospitals and Health Centers endorsed the final version.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field).

Conclusions were based on prospective randomized controlled trials if available, to the exclusion of other data; if randomized controlled trials were not available, observational studies were admitted to consideration. If no such data were available for a given link in the problem formulation, expert opinion was used to estimate effect size.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Central vascular catheter (CVC) infections have a significant impact on patient morbidity, mortality and costs associated with medical care. In a recent analysis, CVC infections were found to be the most costly healthcare-associated infection at $45,814 per infection. CVC infections are also one of the most deadly healthcare-associated infections, with a mortality rate of 12% to 15%. Implementation of CVC infection management guidelines is intended to improve appropriate early antimicrobial treatment of bloodstream infections, standardize infected CVC management and improve patient outcomes.

Potential Harms

- There are some circumstances in which the removal of the infected catheter may not be possible. These are usually circumstances in which either (a) replacing the central vascular catheter (CVC) in another location is not possible (e.g., multiple areas of thrombosis or stenosis or the patient is pediatric with limited access opportunities) or (b) removing the catheter carries prohibitive risk and the benefits of salvage may outweigh the risks of removal. In cases where removal is not possible, the CVC may be left in place during initial antibiotic treatment. In such cases, the clinician must carefully evaluate the risks and benefits of alternative treatments on an individual basis and with the benefit of additional expert guidance. When *Staphylococcus aureus*, *Pseudomonas aeruginosa*, fungus or mycobacteria are present, rates of treatment failure with catheters left in place are high, and in those catheters that fail salvage there is a high incidence of complications stemming from the infection.
- Data supporting the practice of changing CVCs over a wire are weak. In such cases, the clinician must carefully evaluate the risks and benefits of guidewire exchange on an individual basis and with the benefit of additional expert guidance.

- Insertion of a CVC in the presence of an active bloodstream infection may result in colonization and infection of the new catheter, resulting in relapse of bacteremia after treatment. A recent small study showed that peripherally inserted central catheters (PICCs) placed within two days of documented bacteremia had an increased risk of relapse of bacteremia (6.5%) when compared to PICCs place at least three days after documentation of negative blood culture (0.3%). In clinical scenarios where there is ongoing need for central vascular access, clinicians must weigh the risk/benefit of placing a new CVC in the setting of active bacteremia.

Qualifying Statements

Qualifying Statements

Qualifying Statements

These guidelines should not be construed as including all proper methods of care or excluding other acceptable methods of care reasonably directed to obtaining the same results. The ultimate judgment regarding any specific clinical procedure or treatment must be made by the physician in light of the circumstances presented by the patient.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Implementation Tools

Clinical Algorithm

Staff Training/Competency Material

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

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Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2016 Dec

Guideline Developer(s)

University of Michigan Health System - Academic Institution

Source(s) of Funding

The development of this guideline was funded by the University of Michigan Health System.

Guideline Committee

Central Vascular Catheter Guideline Team

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Guideline Status

This is the current release of the guideline.

This guideline meets NGC's 2013 (revised) inclusion criteria.

Guideline Availability

Available from the University of Michigan Health System Web site .

Availability of Companion Documents

The supplemental methodology appendix is available from the University of Michigan Health System (UMHS) Web site .

A self-study continuing medical education (CME) activity for this guideline is also available from the UMHS Web site .

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on June 21, 2017.

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